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Nuclear data needed to develop new nuclear systems, role of n_TOF facilities to measure resonance cross sections and nuclear data needs of thorium fuel cycle

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The development of Accelerator Driven Sub-critical Systems proposed by Carlo Rubbia and others require significant amount of new nuclear data in extended energy regions and significant improvement of the presently available nuclear data. The ADSS concepts have given a fresh look at the use of thorium fuel cycle in a lead-bismuth coolant environment. The nuclear data of isotopes of thorium fuel cycle need new measurements to bring their status to at least to a level on par to those of U-Pu cycle. The talk will present a number of illustrative examples. The Indian participation in the n_TOF programmes stands to benefit not only in her ADSS studies for thorium utilization but also because there is a considerable overlap between the Advanced Heavy Water Reactor (AHWR) and Compact High Temperature Reactor (CHTR) Indian programmes with respect to thorium as a fuel and the on-going international efforts to develop innovative, inherently safe, proliferation-resistant and long-life-cores, with features using thorium such as in INPRO and Generation IV systems.

Reliable design and operator's manual, based upon accurate knowledge of nuclear data, for each stage of the nuclear fuel cycle of the ADSS and other advanced concepts will help in safe use of nuclear energy by providing proper guidance on safety precautions and behaviour under all system conditions. For multiple recycled fuels, the quality of nuclear data of higher isotopes of plutonium, minor actinides (e.g., isotopes of Am and Cm) and fission products need to be brought on par to that of main fissile and fertile nuclei. The role of n_TOF measurements to meet the demands on accurate nuclear data in the extended resolved resonance region that affect plant safety related feedback coefficients such as Doppler and coolant void reactivity effects as a function of burn-up for advanced systems are high. The experimental validation efforts in critical facilities can never exactly verify the simulated states of higher burn-up. Improved nuclear data are therefore essential for fission products and minor actinides in developing advanced reactor systems, such as actinide burner systems and to reduce the number of costly integral experiments.

Preliminary research for the Energy Amplifier concept proposed by Carlo Rubbia and others in the world use existing nuclear data developed for thermal, fast and fusion reactors and those generated towards fundamental physics understanding of the nucleus and applications such as in astrophysics. The quality assurance in design and safety studies in nuclear energy in the next few decades and centuries require new and improved nuclear data with high accuracy and energy resolution that is possible only with the facilities such as the CERN n_TOF. Carefully planned measurements with facilities such as n_TOF are essential as the existing strength of the state-of-the-art nuclear databases in use for various applications is highly commendable but inadequate to meet the nuclear data needs of new reactor concepts as different neutron energy spectra and materials and compositions are involved. As a general rule, the generation of new nuclear data by the international community should continue to be encouraged as more intense neutron sources, purer elemental/isotopic target samples, more efficient detectors and better electronics evolve. Required scientific activities also are extensive follow up of experimental data generation with a comprehensive compilation, critical evaluation, production of new ENDF/B formatted libraries extending to higher energies, and quality assured nuclear data processing activities to provide the designers/users/ of innovative systems with "ready to plug-in"processed data, that are integrally validated, for use in applications.

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